

5.3 OPERATING, STORING, AND TRANSFERRING - PLANS, PROCEDURES, REQUIREMENTS, AND CONTROLS. Operations for which nuclear criticality safety is a consideration addressed by a Nuclear Criticality Safety Evaluation and a Nuclear Criticality Safety Analysis shall be governed by written plans, written procedures, and controls.

5.3.1 General Requirements for Operating Plans and Procedures.

5.3.1.1 Start-up, operations, and modifications. Written plans and procedures for facilities in which nuclear criticality safety is of concern shall cover start-up, operations, and any modifications that may affect nuclear criticality safety. All persons participating in the operation of such facilities shall be familiar with, and understand procedures applicable to, their assigned duties. In this standard, operating plans and procedures include any set of instructions to do work that can affect criticality safety. They include process operating procedures, storage plans, and modification or maintenance work packages that involve significant quantities of fissionable material, associated materials, engineered safety features, and the CAS.

5.3.1.2 NCS parameter identification. Procedures shall clearly specify all nuclear and process parameter limits related to nuclear criticality safety that are intended to be controlled for safety. Nuclear criticality safety steps shall be conspicuously identified in operating procedures and should immediately precede the step or group of steps to which they are applicable. New or revised procedures containing such nuclear safety steps, nuclear criticality safety limits, or nuclear criticality safety requirements shall undergo review and approval by the CSO prior to implementation.

5.3.1.3 Single failure safety assurance. Procedures should be developed such that no single credible inadvertent departure from a procedure can cause a criticality accident.

5.3.1.4 Procedural convenience. Procedures should be convenient for use by operators and should be free of extraneous material.

5.3.1.5 Procedural reviews. Active procedures shall be reviewed periodically by supervision. The requirement to periodically review active procedures shall itself be a procedure. Similarly, operations shall be reviewed at least annually to ascertain that procedures are being followed, and that process or facility conditions have not been altered so as to affect nuclear criticality safety adversely.

5.3.1.6 Supplementation. Procedures should be supplemented as necessary by posted nuclear criticality safety limits or other appropriate operator aids such as inventory lists, process checklists, flowsheets, and engineering drawings as part of an operator aid program in accordance with the reference cited in section 2.1.8.

5.3.1.7 Operational deviations. Deviations from operating procedures and unforeseen alterations in process conditions that affect nuclear criticality safety shall be documented, reported to management, and investigated promptly. Actions shall be taken to prevent a recurrence or to appropriately modify procedures.

5.3.1.8 Process allowances. Following documentation of the safety basis justification for acceptance, suitable allowances may be made for situations where the fissionable material content of products, wastes, or feed materials, or such content under other circumstances, is repetitive or

1 is previously established from the work of others or from process limitations. Examples could
2 include the acceptance of shipper's values for received materials or limitation of material density or
3 concentration because of a specific chemical process.

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5 5.3.1.9 Procedural revisions. Supplementing and revising procedures should be facilitated as
6 improvements become desirable.

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8 **5.3.2 Processing.** Fissionable material processing shall be conducted in an orderly fashion that
9 includes, as appropriate, use of the following:

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11 5.3.2.1 Plans, flowsheets, and layouts. Process plans, flowsheets, and layouts should be
12 developed that describe the process, including equipment and facilities in which criticality hazards
13 may exist, using appropriate drawings/sketches, and including dimensions in sufficient detail to
14 permit the development of procedures specified in sections 5.3.2.2 through 5.3.2.6 to evaluate the
15 process.

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17 5.3.2.2 Procedural description of material composition. Procedures should be developed and used
18 that contain information on the physical and chemical form of fissionable material in the processing
19 operation, including isotopic content, concentrations, densities, and moderation levels of the
20 fissionable material, as applicable and required to ensure criticality safety. This information may be
21 bounded by conservative enveloping assumptions to simplify and eliminate superfluous details.

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23 5.3.2.3 Procedural description of allowed material quantities. Procedures shall be developed and
24 used that contain statements of the maximum quantities or concentrations of fissionable material
25 allowed in the process.

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27 5.3.2.4 Procedural description of spacing requirements. Procedures shall be developed and used
28 that specify required spacing of masses of fissionable material and separation from fissionable
29 material in adjoining areas, as applicable.

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31 5.3.2.5 Procedural specifications for material collection and transport. Procedures shall be
32 developed and used that specify safe methods of collecting, handling, and transporting fissionable
33 material.

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35 5.3.2.6 Procedural specifications for administrative controls. Procedures shall be developed and
36 used that specify administrative methods to prevent criticality.

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38 **5.3.3 Receiving and Inspecting Fissionable Material.** The following procedures shall be developed
39 for the receipt and inspection of fissionable materials:

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41 5.3.3.1 Verification. Procedures that are consistent with materials controls and accountability
42 requirements shall be developed and used for determining, verifying, or noting the contents of each
43 package, including the net weight of the fissionable material therein.

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45 5.3.3.2 Material placement. Procedures shall be developed and used for placing fissionable
46 materials in receiving areas and storage facilities.

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48 **5.3.4 Storing Fissionable Material.** The requirements of this section do not apply (a) when
49 materials are in-process as part of production, analytical and developmental procedures, or

transport operations, (b) when an assembly cell is used for assembly and/or storage of weapons components made with these materials, (c) when the number of packages of materials prepared for shipment is limited in accordance with the requirements of DOE Order 5480.3, or (d) to radioactive waste storage or disposal facilities. However, plans and procedures for storing all other fissionable materials shall include, as appropriate, the following:

5.3.4.1 Facility design criteria. Design criteria for fissionable material storage facilities should meet the requirements of DOE Order 6430.1A. In facilities storing combinations of fissionable materials (e.g., enriched uranium and plutonium), the relative risk of the materials shall be evaluated, and the more conservative material facility design criteria should be adopted. The storage of fissionable materials shall be such as to obviate concern with accidental nuclear criticality in the event of fire or flood, earthquake, or other natural calamities.¹⁴ In addition, the design of storage structures should tend to preclude unacceptable arrangements or configurations, thereby reducing reliance on administrative controls.¹⁵

5.3.4.2 Storage specifications. Procedures shall be developed and used for storing fissionable material that set forth limits on the total quantity of fissionable material, allowable quantity of individual units, allowable container dimensions, and required spacing of containers in storage areas.

5.3.4.3 Container descriptions. Procedures shall be developed and used for storing fissionable material that contain descriptions or identify types of containers in which fissionable materials are allowed to be stored.

5.3.4.4 Storage facility plans and layouts. Plans and layouts shall be developed that contain a description of the storage facility, including dimensions and materials used in construction of the enclosure and shelving, cubicles, cages, and other equipment within the storage area.

5.3.4.5 Admonitions about moderating and reflecting materials. Procedures shall be developed and used that contain precautions to avoid entry of water or other moderating materials into a storage area where moderating and reflecting effects of such materials would be unsafe. Nonessential combustible materials shall not be stored in a fissionable material storage area.

5.3.4.6 Removal and return of materials. Procedures shall be developed and used that control the removal, or transfer, of fissionable material from storage and the return of such material to storage. These procedures shall incorporate means of verifying the weight, isotopic content, chemical composition, and degree of moderation, as appropriate.

5.3.4.7 Exclusion of superfluous materials. Process operations, storage of non-nuclear materials or equipment that is not directly required for fissionable materials storage operations, and all other functions not directly a part of normal fissionable materials storage operations should be excluded from the storage area.

¹⁴ANSI/ANS-8.7-1975,R87, "Guide for Nuclear Criticality Safety in the Storage of Fissile Materials," paragraph 4.2.3.

¹⁵ANSI/ANS-8.7-1975,R87, "Guide for Nuclear Criticality Safety in the Storage of Fissile Materials," paragraph 4.2.4.

5.3.4.8 Readiness inspections. Documented inspections, *in situ* tests, and preventive maintenance shall be performed periodically on fissionable material storage areas to ensure that the safety systems and components necessary for criticality safety control are maintained in a state of readiness.

5.3.4.9 Postings. Nuclear criticality safety limits shall be conspicuously posted at the entrance and inside fissionable material storage areas, as applicable.

5.3.4.10 Instructions. Signs or other devices shall be utilized as appropriate at strategic locations in or near fissionable material storage locations to provide instructions regarding interpretations of, and required responses to, alarms, evacuation routes, and fire fighting.

5.3.4.11 Emergency planning. In conjunction with site emergency planning, a fire fighting plan shall be developed for fissionable material storage areas and incorporated into the overall facility and site plans. Periodic training drills/exercises shall be conducted appropriate to the level of fire hazard associated with the area.

5.3.4.12 Exclusion from storage requirements. Excess fissionable material shall not be construed to be "in process" to circumvent the fissionable material storage requirements of this section.

5.3.4.13 Use of shipping containers. Fissionable material may be stored in shipping containers for the purpose of enhancing safety in storage, but not for the purpose of negating the requirements of this section.

5.3.4.14 Material constraints. All fissionable material shall be stored in racks or equivalent fixtures capable of securely locating stored material in order to prevent displacement, to ensure spacing control, and to meet designs for criticality safety under normal operational and credible accident conditions. Floor storage within a fissionable material storage facility shall only be permitted where control of location or other safety requirements (equivalent to the safety provided by storage racks) are inherently provided by the original containers and their restraints if required for nuclear criticality safety.

5.3.4.15 Pyrophoric materials. All fissionable materials that are determined to be pyrophoric shall be put in a safe form (i.e., non-pyrophoric) prior to storage or be stored in approved containers or inert atmospheres that will not permit spontaneous ignition or dispersal.

5.3.4.16 Container identification and closure. All fissionable material storage containers shall be marked and, if practical, coded to indicate the type or category of material, amount, degree of enrichment, moderation, and the radiation level at the outside surface of the container as appropriate to monitor criticality safety parameter limits and controls. Containers shall be securely closed and positioned so as to prevent significant displacement and maintain criticality prevention requirements.

5.3.4.17 Container design. Fissionable material container design shall be appropriate to the form of stored fissionable material. Criteria for container integrity shall be developed in the course of the required safety analysis and the applications of such criteria evaluated by periodic inspection (by facility personnel). For containers involving any significant gas buildup, automatic pressure relief or other venting should be designed to ensure that no personnel exposure to any toxic material will

occur under normal storage conditions, or, insofar as practical, under credible accident conditions. Such venting shall not permit the spread of contamination.

5.3.4.18 Containerization of plutonium or ^{233}U . Plutonium- or ^{233}U -bearing, or -contaminated, material shall be packaged in a closed metal container. Combustibles within the container shall be minimized. Hydrogenous materials ("plastics") shall not be used for plutonium packaging. These considerations may also be applicable to ^{233}U . (See also DOE-STD-3013-94, section 2.1.20 of this standard.)

5.3.4.19 Plutonium storage monitoring. Plutonium storage facilities and containers shall be monitored and checked periodically to ensure continued integrity of containment. When required by the form or hazard potential of the stored material, procedures shall be developed to detect contamination or loss of primary containment when personnel enter the plutonium storage facility.

5.3.4.20 Container venting. Plutonium containers in which gas buildup can occur shall be designed to prevent leakage of gas over the maximum storage period, or vented to prevent an accumulation of explosive gases; however, such venting shall not permit the spread of contamination.

5.3.4.21 Container criteria. Criteria, such as external and internal corrosion rate for determining the suitability of containers in storage, shall be developed as necessary and set forth in writing. These criteria are particularly important in water pool storage of fuel elements or containerized fissionable materials and in the storage of plutonium or ^{233}U . All storage containers shall be periodically inspected against the criteria developed. The time between inspections may vary depending upon storage container quality and type. Procedures for conducting these inspections or surveillances shall include acceptance criteria for corrosion and other phenomena that can adversely affect criticality safety.

5.3.4.22 Heat removal. Provisions shall be made in a plutonium storage facility to ensure necessary and adequate heat removal for plutonium storage containers as established by facility safety assessments.

5.3.5 Fissionable Material Transportation. The transportation of fissionable materials onsite and offsite shall be governed by written procedures that comply with DOE Order 420.1, Section 4.3, DOE Order 5480.3, 49 CFR, 10 CFR 71, and other applicable federal requirements.

5.3.5.1 Onsite transfers. The design and use of onsite shipping containers shall provide criticality safety protection of fissionable material consistent with that protection provided by DOE, NRC, or DOT packages used in interstate transport. Considerations should be given to onsite resources and conditions of material transport that eliminate or mitigate interstate transport hazards (e.g., resources of prompt fire fighting, speed limits of transport, traffic control, method of transport, compensation for weather conditions, lifting height restraints, and others).

5.3.5.1.1 Onsite transport safety analysis. The packaging requirements for onsite transfer of fissionable material are contained in DOE Order 5480.3. Safety analysis for onsite transfers must be in accordance with requirements in this DOE Order. The safety analysis, computational evaluations, and the documentation of the package safety analysis shall be performed in accordance with DOE Order 420.1, Section 4.3.

5.3.5.1.2 Operating procedures. Approved operating procedures applicable to an onsite transfer or shipment of fissionable materials shall be posted or readily available within the loading, unloading, or storage areas for such materials.

5.3.5.2 Offsite transfers. All transfers of fissionable materials offsite shall be performed in DOE, NRC, or DOT approved fissionable material packages. All required administrative controls and procedures specified for the package use shall be performed. Such DOE, NRC, or DOT approved packages do not require additional criticality safety review for receipt or shipment.

5.3.6 Posting and Labeling. Positive identification of fissionable material is essential to criticality safety. Adequate labeling of fissionable material and clear posting of work and storage areas in which fissionable materials are present are important in avoiding the accumulation of unsafe quantities of such materials. Detailed guidance for posting and labeling follow.

5.3.6.1 Posting of Fissionable Material Handling, Storage, and Work Areas. Posting refers to the placement of signs to indicate the presence of fissionable material, to summarize key criticality safety requirements and limits, to designate work and storage areas, or to provide instruction or warning to personnel.

5.3.6.1.1 Presence of fissionable materials. The presence of significant quantities of fissionable material shall be posted at the entrance to work and storage areas such as benches, hoods, glove boxes, cabinets, rooms, zones, and modules where fissionable material is handled, processed, or stored. This posting to identify the presence of significant quantities of fissionable materials may be at the entrance to work areas or storage areas, at room entrances, or entrances to buildings, as appropriate. Such areas shall be periodically reviewed to eliminate extraneous postings. For example, criticality safety requirements should be posted only for those gloveboxes or rooms currently containing, or that are intended to contain, significant quantities of fissionable material in the near future. Postings should be coordinated with the current list of required postings and ongoing implementation of nuclear criticality safety evaluations and analyses.

5.3.6.1.2 Symbol. The identification symbol used to identify the presence of all fissionable materials shall be as specified in ANSI Standard No. 12.1 and is referred to as the "fissionable material symbol." See Figure 5.3.6.1.2-1. The fissionable material symbol consists of three curved bars around the standard radiation symbol with the word "fissionable" superimposed on the bars. The symbol shall be magenta, purple, or black on a yellow background.



Figure 5.3.6.1.2-1. Fissionable material symbol

5.3.6.1.3 Storage postings. For fissionable material storage locations, criticality safety limits shall be posted in conspicuous places near such storage locations. Postings shall include, as appropriate, the following information: type of fissionable material, containers, and packages allowed; mass, number of units, surface density, and volume allowed; moderation limits; and spacing limits. However, in the case of spent fuel storage pools, such postings need only contain criticality safety limit information, such as "only one assembly in motion at a time."

5.3.6.1.4 Process limits. For process areas, limits and controls that are controllable or observable by an operator shall be posted at each work station as necessary to supplement operating procedures (e.g., Hood Limit - 15 one-liter bottles). However, care should be exercised to avoid posting so many limits that confusion develops.

5.3.6.1.5 Uniformity of postings. Each process facility should develop facility-specific criteria to be used as a basis for determining the limits and controls to be posted versus those controls that will only appear in operating procedures.

5.3.6.1.6 Administrative control postings. For laboratories or other areas using administrative mass control limits for individual labs, groups of labs, or isolated locations, such limits shall be posted at the entry of each such area.

5.3.6.1.7 Precautions or prohibitions. Criticality safety precautions or prohibitions related to fire fighting such as prohibitions or precautions in the use of water, use of fog nozzles only, and limitations of direct high pressure water sprays shall be posted at the entrance to areas containing fissionable material, as appropriate.

5.3.6.1.8 Visibility of postings, operator aids. Text of postings for criticality safety shall be easy to read; non-verbal items such as fuel assembly identification silhouettes and process mimic boards shall be equally discernible. Each posting or operator aid shall be located in such a manner that it may be easily seen while the operator is performing duties to which that operator aid applies.

5.3.6.2 Labeling Requirements for Fissionable Material. Labeling refers to the placement of clear and positive identifying markings on specific units or batches of fissionable material such as cans, packages, containers, birdcages, boxes, reactor fuel assemblies, and targets to prevent their being mistaken for other materials. If practical, labels shall clearly show the type and amount of fissionable material present.

5.3.6.2.1 Label. For the purposes of this guide, label may be interpreted to mean a label, an identification/serial number, or a tag affixed to the fissionable material assembly, container, or equipment. Wherever practical, labels should be machine readable or integral with a machine readable code, e.g., bar code.

5.3.6.2.2 Attachment. Containers of fissionable material received from offsite that meet the requirements of DOE Order 5480.3 shall have a label affixed unless an unusually high radiation dose will result. If an unusually high dose will result from labeling, the nuclear criticality safety organization shall be advised and shall determine an appropriate course of action consistent with the intent of this section.

5.3.6.2.3 Contained information. Labels shall clearly show all information necessary to ensure adequate identification of fissionable materials. Generally, this information should include the type, form, moderation, enrichment, and quantity of fissionable material.

5.3.6.2.4 Specialized needs. Labels may be developed by each division or fissionable material control area to suit their own needs. However, when fissionable materials or containers of fissionable material are to be transported between facilities onsite, the sending and receiving facilities should agree in advance on the type of labeling required.

5.3.6.2.5 Unirradiated reactor fuel/targets. Label requirements for unirradiated reactor fuel and targets shall consist of a unique serial number etched/machined onto each reactor fuel element and target and accompanying paperwork/cards, matched to each serial number, which provides the type of information described in section 5.3.6.2.3.

5.3.6.2.6 Irradiated reactor fuel/targets. Label requirements for irradiated reactor fuel elements and targets shall be similar to those for unirradiated reactor fuel elements and targets. However, irradiated fuel/targets shall contain information such as lists of fuel element/assembly serial numbers matched to paperwork containing information of the type described in section 5.3.6.2.3.

5.3.6.3 Empty containers. Fissionable material containers that no longer contain fissionable material (other than that present as residual contamination) should be labeled as empty, or unloaded as appropriate, or the old fissionable material labeling should be unmistakably crossed out, unless the absence of fissionable material is readily apparent.